

CLAIM LISTING

1. (Amended) A method of operating a fuel cell having a PEM as the electrolyte, an anode method of on one side of the PEM, a cathode on the other side of the PEM, an external electric circuit connecting the anode and cathode, and a primary electricity using device within the external circuit, comprising the steps of
 - A. providing a hydrogen containing fuel to the anode and an oxygen containing oxidant to the cathode to generate, for a first period of time, an electric current within the external circuit for operating the primary electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;
 - B. regenerating the cell after Step A by a) providing a hydrogen containing fuel to the anode while operating said cell using procedures selected to reduce the cathode potential to below 0.50 volt, said procedures including the steps of i) stopping the flow of oxidant to the cell, ii) disconnecting the primary electricity using device and replacing it with a battery in the external circuit, and iii) providing a flow of hydrogen containing gas to the cathode, and b) maintaining the cathode potential below the said 0.50 volt for a second period of time sufficient to essentially restore the cell performance decrease which occurred during the course of Step A; and,
 - C. sequentially repeating Steps A and B to reduce the decrease in cell performance over time.
2. (Original) The method according to claim 1, wherein in Step B the cathode potential is maintained at 0.1 volt or less for said second period of time.
3. (Cancelled)
4. (Cancelled)
5. (Cancelled)
6. (Cancelled)
7. (Cancelled)
8. (Original) A method of operating a fuel cell having a PEM as the electrolyte, an anode on one side of the PEM, a cathode on the other side of the PEM, an

CLAIM LISTING

- external electric circuit connecting the anode and cathode, and a primary electricity using device within the external circuit, comprising the steps of
- A. providing a hydrogen containing fuel to the anode and an oxygen containing oxidant to the cathode to generate, for a first period of time, an electric current within the external circuit for operating the primary electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;
 - B. regenerating the cell after Step A by a) providing a hydrogen containing fuel to the anode while operating said cell using procedures selected to reduce the cathode potential to below 0.50 volt, said procedures including the steps of i) stopping the flow of oxidant to the cell and replacing it with a flow of inert gas, and ii) disconnecting the electricity using device from the circuit and leaving the circuit open until the cathode potential falls to below 0.5 volt, and b) maintaining the cathode potential below the said 0.50 volt for a second period of time sufficient to essentially restore the cell performance decrease which occurred during the course of Step A; and,
 - C. sequentially repeating Steps A and B to reduce the decrease in cell performance over time.

9. (Original) The method according to claim 8, wherein in Step B the cathode potential is maintained at 0.1 volt or less for said second period of time.

10. (New) A method of operating a fuel cell having a PEM as the electrolyte, an anode on one side of the PEM, a cathode on the other side of the PEM, an external electric circuit connecting the anode and cathode, and a primary electricity using device within the external circuit, comprising the steps of

- A. providing a hydrogen containing fuel to the anode and an oxygen containing oxidant to the cathode to generate, for a first period of time, an electric current within the external circuit for operating the primary electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;

CLAIM LISTING

11 B. regenerating the cell after Step A by a) providing a hydrogen containing fuel to
12 the anode while operating said cell using procedures selected to reduce the
13 cathode potential to below 0.50 volt, said procedures including the steps of
14 i) disconnecting the primary electricity using device from the external circuit
15 and connecting an auxiliary resistive load in its place, and ii) stopping the
16 flow of oxidant to the cell and allowing the oxidant remaining within the cell
17 to be consumed at the cathode creating a current flow through the auxiliary
18 resistive load within the external circuit; and, b) maintaining the cathode
19 potential below the said 0.50 volt for a second period of time sufficient to
20 essentially restore the cell performance decrease which occurred during the
21 course of Step A; and,

22 C. sequentially repeating Steps A and B to reduce the decrease in cell performance
23 over time.

1 11. (New) The method according to claim 10, wherein in Step B said cell operating
2 procedures are selected to reduce cathode potential to 0.1 volt or less for said
3 second period of time.

1 12. (New) A method of operating a fuel cell having a PEM as the electrolyte, an anode on
2 one side of the PEM, a cathode on the other side of the PEM, an external electric
3 circuit connecting the anode and cathode, and a primary electricity using device
4 within the external circuit, comprising the steps of

5 A. providing a hydrogen containing fuel to the anode and an oxygen containing
6 oxidant to the cathode to generate, for a first period of time, an electric
7 current within the external circuit for operating the primary electricity using
8 device, the cell operating conditions being selected such that, during the
9 course of said first period of time, the cathode potential is maintained above
10 0.66 volt and cell performance decreases;

11 B. regenerating the cell after Step A while the primary electricity using device
12 within the external circuit remains connected across the anode and cathode
13 and while continuing to provide a hydrogen containing fuel to the anode and
14 an oxygen containing oxidant to the cathode using procedures selected to
15 reduce the cathode potential to below 0.50 volt for a second period of time

CLAIM LISTING

16 sufficient to essentially restore the cell performance decrease which occurred
17 during the course of Step A, said procedures including increasing the
18 oxidant utilization to at least 70% for said second period of time; and,
19 C. sequentially repeating Steps A and B to reduce the decrease in cell
20 performance over time.

1 13. (New) A method of operating a fuel cell having a PEM as the electrolyte, an anode on
2 one side of the PEM, a cathode on the other side of the PEM, an external electric
3 circuit connecting the anode and cathode, and a primary electricity using device
4 within the external circuit, comprising the steps of

5 A. providing a hydrogen containing fuel to the anode and an oxygen containing
6 oxidant to the cathode to generate, for a first period of time, an electric
7 current within the external circuit for operating the primary electricity using
8 device, the cell operating conditions being selected such that, during the
9 course of said first period of time, the cathode potential is maintained above
10 0.66 volt and cell performance decreases;

11 B. regenerating the cell after Step A while the primary electricity using device
12 within the external circuit remains connected across the anode and cathode
13 and while continuing to provide a hydrogen containing fuel to the anode and
14 an oxygen containing oxidant to the cathode using procedures selected to
15 reduce the cathode potential to below 0.50 volt for a second period of time
16 sufficient to essentially restore the cell performance decrease which occurred
17 during the course of Step A, said procedures including increasing the current
18 for said second period of time; and,

19 C. sequentially repeating Steps A and B to reduce the decrease in cell
20 performance over time.

1 14. (New) A method of operating a fuel cell having a PEM as the electrolyte, an anode on
2 one side of the PEM, a cathode on the other side of the PEM, an external electric
3 circuit connecting the anode and cathode, and a primary electricity using device
4 within the external circuit, comprising the steps of

5 A. providing a hydrogen containing fuel to the anode and an oxygen containing
6 oxidant to the cathode to generate, for a first period of time, an electric

CLAIM LISTING

current within the external circuit for operating the primary electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;

B. regenerating the cell after Step A by

a) providing a hydrogen containing fuel to the anode while operating said cell using procedures selected to reduce the cathode potential to below 0.50 volt, said procedures including the steps of i) stopping the flow of oxidant to the cell and replacing it with a flow of inert gas, and ii) disconnecting the primary electricity using device from the circuit and connecting an auxiliary resistive load in its place; and,

b) maintaining the cathode potential below the said 0.50 volt for a second period of time sufficient to essentially restore the cell performance decrease which occurred during the course of Step A; and,

C. sequentially repeating Steps A and B to reduce the decrease in cell performance over time.

15. (New) A method of operating a fuel cell having a PEM as the electrolyte, an anode on one side of the PEM, a cathode on the other side of the PEM, an external electric circuit connecting the anode and cathode, and a primary electricity using device within the external circuit, comprising the steps of

A. providing a hydrogen containing fuel to the anode and an oxygen containing oxidant to the cathode to generate, for a first period of time, an electric current within the external circuit for operating the primary electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;

B. regenerating the cell after Step A by

a) providing a hydrogen containing fuel to the anode while operating said cell using procedures selected to reduce the cathode potential to below 0.50 volt, said procedures including the steps of i) stopping the flow of oxidant to the cathode and replacing it with a flow of hydrogen, ii) disconnecting

CLAIM LISTING

the primary electricity using device from the circuit and leaving the circuit open until the cathode potential falls to below 0.50 volt; and, b) maintaining the cathode potential below the said 0.50 volt for a second period of time sufficient to essentially restore the cell performance decrease which occurred during the course of Step A; and,

C. sequentially repeating Steps A and B to reduce the decrease in cell performance over time.

16. (New) A method of operating a fuel cell having a PEM as the electrolyte, an anode on one side of the PEM, a cathode on the other side of the PEM, an external electric circuit connecting the anode and cathode, and a primary electricity using device within the external circuit, comprising the steps of

A. providing a hydrogen containing fuel to the anode and an oxygen containing oxidant to the cathode to generate, for a first period of time, an electric current within the external circuit for operating the primary electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;

B. regenerating the cell after Step A by

a) providing a hydrogen containing fuel to the anode while operating said cell using procedures selected to reduce the cathode potential to below 0.50 volt, said procedures including the steps of i) stopping the flow of oxidant to the cell, and ii) disconnecting the primary electricity using device and replacing it with a power supply in the external circuit, and

b) maintaining the cathode potential below the said 0.50 volt for a second period of time sufficient to essentially restore the cell performance decrease which occurred during the course of Step A; and,

C. sequentially repeating Steps A and B to reduce the decrease in cell performance over time.

17. (New) The method according to claim 16, including, in Step B, in addition to steps i) and ii), step iii) providing a flow of hydrogen containing gas to the cathode.

CLAIM LISTING

1 18. (New) A method of operating a fuel cell having a PEM as the electrolyte, an
2 anode on one side of the PEM, a cathode on the other side of the PEM, an
3 external electric circuit connecting the anode and cathode, and a primary
4 electricity using device within the external circuit, comprising the steps of
5 A. providing a hydrogen containing fuel to the anode and an oxygen
6 containing oxidant to the cathode to generate, for a first period of time, an
7 electric current within the external circuit for operating the primary
8 electricity using device, the cell operating conditions being selected such
9 that, during the course of said first period of time, the cathode potential is
10 maintained above 0.66 volt and cell performance decreases;
11 B. regenerating the cell after Step A by a) providing a hydrogen containing
12 fuel to the anode while operating said cell using procedures selected to
13 reduce the cathode potential to below 0.50 volt, said procedures including
14 the steps of i) stopping the flow of oxidant to the cell and replacing it with
15 a flow of gas selected from the group consisting of carbon dioxide,
16 methane, natural gas, propane, and butane, and ii) disconnecting the
17 primary electricity using device from the circuit and leaving the circuit
18 open until the cathode potential falls to below 0.5 volt; and, b) maintaining
19 the cathode potential below the said 0.50 volt for a second period of time
20 sufficient to essentially restore the cell performance decrease which
21 occurred during the course of Step A; and,
22 C. sequentially repeating Steps A and B to reduce the decrease in cell
23 performance over time.

1 19. (New) A method of operating a fuel cell having a PEM as the electrolyte, an
2 anode on one side of the PEM, a cathode on the other side of the PEM, an
3 external electric circuit connecting the anode and cathode, and a primary
4 electricity using device within the external circuit, comprising the steps of
5 A. providing a hydrogen containing fuel to the anode and an oxygen
6 containing oxidant to the cathode to generate, for a first period of time, an
7 electric current within the external circuit for operating the primary

CLAIM LISTING

electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;

B. regenerating the cell after Step A by

a) providing a hydrogen containing fuel to the anode while operating said cell using procedures selected to reduce the cathode potential to below 0.50 volt, said procedures including the steps of i) stopping the flow of oxidant to the cell and replacing it with a flow of gas selected from the group consisting of carbon dioxide, methane, natural gas, propane, and butane, and ii) disconnecting the primary electricity using device from the circuit and connecting an auxiliary resistive load in its place; and, b) maintaining the cathode potential below the said 0.50 volt for a second period of time sufficient to essentially restore the cell performance decrease which occurred during the course of Step A; and,

C. sequentially repeating Steps A and B to reduce the decrease in cell performance over time.

20. (New) A method of operating a fuel cell having a PEM as the electrolyte, an anode on one side of the PEM, a cathode on the other side of the PEM, an external electric circuit connecting the anode and cathode, and a primary electricity using device within the external circuit, comprising the steps of

A. providing a hydrogen containing fuel to the anode and an oxygen containing oxidant to the cathode to generate, for a first period of time, an electric current within the external circuit for operating the primary electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;

B. regenerating the cell after Step A by a) providing a hydrogen containing fuel to the anode while operating said cell using procedures selected to reduce the cathode potential to below 0.50 volt, said procedures including the steps of i) stopping the flow of oxidant to the cell and replacing it with a flow of inert gas, and ii) disconnecting the primary electricity using

CLAIM LISTING

device from the circuit and leaving the circuit open until the cathode potential falls to below 0.5 volt, and b) maintaining the cathode potential below the said 0.50 volt for a second period of time sufficient to restore at least a major portion of the cell performance decrease which occurred during the course of Step A; and,

C. sequentially repeating Steps A and B to reduce the decrease in cell performance over time.

21. (New) A method of operating a fuel cell having a PEM as the electrolyte, an anode on one side of the PEM, a cathode on the other side of the PEM, an external electric circuit connecting the anode and cathode, and a primary electricity using device within the external circuit, comprising the steps of
A. providing a hydrogen containing fuel to the anode and an oxygen containing oxidant to the cathode to generate, for a first period of time, an electric current within the external circuit for operating the primary electricity using device, the cell operating conditions being selected such that, during the course of said first period of time, the cathode potential is maintained above 0.66 volt and cell performance decreases;
B. regenerating the cell after Step A by a) providing a hydrogen containing fuel to the anode while operating said cell using procedures selected to reduce the cathode potential to below 0.50 volt, said procedures including the steps of i) disconnecting the primary electricity using device from the external circuit, and ii) with an auxiliary resistive load connected across the cell, stopping the flow of oxidant to the cell and allowing the oxidant remaining within the cell to be consumed at the cathode creating a current flow through the auxiliary resistive load; and,
b) maintaining the cathode potential below the said 0.50 volt for a second period of time sufficient to essentially restore the cell performance decrease which occurred during the course of Step A; and,
C. sequentially repeating Steps A and B to reduce the decrease in cell performance over time.